

AIR WAR COLLEGE

AIR UNIVERSITY

PROVIDING COMMAND AND CONTROL COMMUNICATIONS  
TO COMMANDERS ABOARD MOBILITY AIRLIFT PLATFORMS

by

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A Research Report Submitted to the Faculty

In Partial Fulfillment of the Graduation Requirements

12 February 2009

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>FEB 2009</b>		2. REPORT TYPE <b>N/A</b>		3. DATES COVERED <b>-</b>	
4. TITLE AND SUBTITLE <b>Providing Command And Control Communications To Commanders Aboard Mobility Airlift Platforms</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Air War College, Air university Maxwell Air Force Base, Alabama</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release, distribution unlimited</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>SAR</b>	18. NUMBER OF PAGES <b>38</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

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## Introduction

The current and planned command and control communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems for existing and future aircraft weapon systems are inadequate to support commanders on the contemporary battlefield and inconsistent with Service requirements particularly while conducting counterinsurgency operations. Historically, the demand for information in the military has increased ahead of the technological capability to provide adequate services. Future battlefields will continue this paradigm. In order to achieve information dominance, C4ISR requirements must be met in every combat and support aircraft planned by the military Services. The effectiveness of the combat force depends on the capability to extend required and identified information systems to commanders while in transit on mobility aircraft regardless of location, platform, or speed of movement. Information blackout periods associated with troop movements are no longer acceptable and can be overcome by available technology insertion. The confluence of technology and the threat from an elusive foe in the ongoing combat against terrorism has modified the conduct of military operations immensely. Technology provides the means to find, fix, and finish missions at a faster tempo and magnifies the need to improve the existing C4ISR capabilities to extend those services to any location. Nowhere is this lack of connectivity and capability more apparent than within the confines of mobility aircraft.

The effect of technology, when employed properly, provides an immeasurable advantage for the United States in its continuous pursuit and persecution of terrorist movements. The success of man hunting operations, simultaneous with counterinsurgency operations, has produced an environment in Iraq that will eventually achieve the initial strategic goals established earlier in the decade. Technology enables commanders at all levels to achieve never-

before realized speed on the battlefield, but US forces are in the technical infancy of this airborne C4ISR capability. The Services still have much to understand, procure, and institute in order to realize the true effectiveness of technology – particularly information technology – on the modern battlefield. The constantly constricting decision loops of US commanders have pushed terrorists into increasingly remote locations, both physically and socially. Although a considerable advantage to US forces, the isolation of the enemy and the diversity of the battlefield require commanders to remain mobile to remain effective. This required mobility stresses the traditional C4ISR architecture currently based on a fixed operations center established in secure locations. Increasingly capable C4ISR suites must remain mobile and contiguous to the commanders particularly during long duration flights in order to increase the effectiveness of commanders and subsequently saving the lives of their men and women.

In the combat environment where technology is a major US advantage, the commander requires the capability to observe and direct actions across his battlespace. The introduction of modern information technology on today's battlefield has significantly increased the awareness and intelligence available to the commander and his staff. With the traditional focus of intelligence and operational control fixed in the operations center, much of this C4ISR capability is not distributed to locations requiring the presence of the commander. As a result, the commander often weighs the risks of moving to the position where he can best influence the operation or remaining static at the operations center – the location with the best C4ISR support. The information and mobility requirements dictate that effective commanders must be able to receive all available resources regardless of location. Technology exists to provide effectual command and control communications capability; however, the infrastructure to support that capability to a commander on the move in a dynamic battlespace is not in place. The armed

forces must work together to ensure a reliable architecture is available for all commanders at any location to include while in-flight aboard mobility airlift.

The realization of truly flexible command and control of a fluid battle environment will arrive once systems and services available in a fixed operations center are extended, at a similar level of performance, to a commander in flight whether on rotary wing aircraft below the coordinating altitude, within contested city limits, or at 35,000 feet on a transoceanic flight.<sup>1</sup> Success on today's battlefield is accentuated by comparatively primitive technology solutions emplaced to achieve a limited degree of information services to the commander. As the enemy continues to understand and counter our tactics, techniques, and procedures, success in the future will depend on a more robust and near seamless C4ISR capability to the mobile commander at all levels and operating in all environments.

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<sup>1</sup> Joint Publication 3-52. "Joint Doctrine for Airspace Control in the Combat Zone." 30 August 2004, III-4

## Command Requirement

“Commanders do not visit troops in combat. They command from different locations.”<sup>2</sup>

LTG Stanley A. McChrystal

The quote from Lieutenant General Stanley A. McChrystal, Commander of a CENTCOM Joint Task Force, is indicative of the environment commanders experience in counterinsurgency and man hunting operations in the modern battlespaces. The battle environment in Iraq and Afghanistan is truly multidimensional covering much different areas and challenges not delineated or identified in traditional doctrine for a standard ground force. Commanders from the strategic to the tactical levels operate in a variety of environments against a continuously adjusting foe. Commanders must maneuver the length and width of a city street while synchronizing air assets to provide the intelligence and firepower needed to find, fix, and then finish the enemy. A commander may orchestrate a complex, multi-axis movement in a desert involving ground and air maneuver elements, air and ground intelligence, surveillance, and reconnaissance (ISR) assets, and a variety of other support elements. These missions often include civil affairs and humanitarian assistance factors in close proximity to hostile activities. The geography combined with an enemy interspersed within the society provides diverse challenges to the combat force and the systems intended to provide C4ISR support.

The difference in terrain combined with an enemy nearly indistinguishable from the local populace requires a large investment of intelligence to find and fix the enemy before bringing them to proper justice. The ISR systems must saturate an area for an extended period to develop patterns of life and expose the network. Eventually, with the combination of other intelligence and operational planning systems, the enemy network will betray the intended high value target.<sup>3</sup> The amount of information required by the commander to launch a finish force is traditionally available at only locations supported by heavy, fixed communications systems. For this reason,



in the past, commanders rarely decided to depart the hub of command and control in order to circulate the battlefield to observe and influence operations of his unit personally. Today, static commanders lack true familiarity with the combat environment of his forces.

Commanders require the same information whether at a fixed command post or while moving to, "...command from another location."<sup>4</sup> The command information requirement exceeds the fidelity standards for common situational awareness. For instance, full motion video feeds are reduced in bandwidth by a magnitude of ten in order to distribute the visual picture around the battlefield to disadvantaged locations. The savings in bandwidth has a correspondingly adverse impact on video clarity providing a video image not worthy of true analysis, but more appropriately solely for the purpose of situational awareness. The quality of video information at a fixed command post is significantly superior and unambiguous than the video extended to a mobile commander. Yet the standard for information quality and accuracy to a commander remains the same regardless of location. C4ISR requirements for commanders of the modern and future battlefield must be met, regardless of location, in order to be effective in modern combat. Commanders' information requirements continue to grow, but are not adequately supported by existing information technology systems particularly on aircraft and other mobility platforms.

The location of the commander is the specific point from which command and control emanates.<sup>5</sup> The commander's requirement for information and increased mobility drives the need to extend critical command and control communications networks and intelligence, surveillance, and reconnaissance systems to any command location. The threat of remotely triggered improvised explosive devices (IED) combined with the fluid nature of the battlefield impels commanders to move rapidly across their battlespace via aircraft in order to command

from a critical location at a decisive time. The distinct technological advantage of the US in this asymmetric fight forces the military to expend every available resource to extend information systems to the commander while in flight in order to eliminate the blackout period he has traditionally been without critical combat information. Commanders, and the forces he leads, cannot afford significant periods without direct contact. Seconds are critical in commanding forces executing continuous combat cycles and have proven to be the difference in critical combat operations such as missed opportunities to capture or kill high value targets.

The extension of critical communications systems to any possible command location is consistent with the priorities identified in the Quadrennial Defense Review (QDR) in 2006. The intent of the Global Information Grid, a priority project specifically identified in the QDR, is to extend high capacity, assured communications among the installations and locations of the US military.<sup>6</sup> The GIG-Bandwidth Expansion program specifically targeted the improvements of intelligence communications to assist in supporting net-centric warfare through ubiquitous bandwidth. The QDR defines the GIG as "...a globally interconnected, end-to-end set of trusted and protected information networks."<sup>7</sup> It also directed the Department of Defense to "...develop a new bandwidth requirements model to determine optimal network size and capability to best support operational forces."<sup>8</sup> Subsequently, the expansion of the GIG allowed the promulgation of intelligence products to a lower level of the military services. The resulting merger of intelligence and operations skill sets relates to the commander's requirement for critical communications at any location.<sup>9</sup> The enhancement of bandwidth to critical locations significantly increased the information available to commanders in locations accessible with fixed infrastructure such as high capacity fiber optic cable during the initial phases of

implementation. The concept extends beyond fixed infrastructure to the point of command – the location of the commander. It directs the same capability at all command locations.

Similar to the plans to extend situational awareness and critical information to a pilot in the cockpit, a solution is required to support commanders airborne as passengers on mobility aircraft. The high capacity C4ISR capabilities resident in a permanent operating location must be extended to the seat of the leader of combat forces aboard any aircraft in any theater.

Similarly, the Army's Future Combat System (FCS) complements the GIG and plans to extend data, voice, and video to commanders on various ground mobility platforms. The same approach is essential in today's combat environment in all aircraft. To provide adequate C4ISR support to maneuver commanders requires a close relationship among the Air Force and the other Services. The Air Force, and all Services, must view C4ISR support as critical task aboard all widebody aircraft supporting expeditionary operations and contingency missions.

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<sup>2</sup> Initial Commander's Inbrief, AUG 2006

<sup>3</sup> Michael T. Flynn, Rich Juergens, and Thomas L. Cantrell, "Employing ISR: SOF Best Practices," Joint Force Quarterly, Issue 50, (3<sup>rd</sup> Quarter 2008): 57.

<sup>4</sup> McChrystal

<sup>5</sup> Joint Publication 3-0, "*Joint Operations*," 13 February 2008, III-10

<sup>6</sup> Quadrennial Defense Review Report. 6 February 2006, p. 58.

<sup>7</sup> Ibid, p. 58

<sup>8</sup> Ibid, p. 59

<sup>9</sup> Michael T. Flynn, Rich Juergens, and Thomas L. Cantrell, "Employing ISR: SOF Best Practices," Joint Force Quarterly, Issue 50, (3<sup>rd</sup> Quarter 2008): 57.

## Command Requirements

The Army Field Manual for Operations (FM 3-0) defines command as, "... the authority a commander in military Service lawfully exercises over subordinates by virtue of rank and assignment."<sup>10</sup> Command is influence irrelevant to the commander's location on the battlefield. FM 3-0 defines a command post as the location of the commander and not a fixed grid coordinate on the battlefield:

Command occurs at the commander's location, whether at a command post, infiltrating at night with light infantry elements, or in a combat vehicle with the decisive operation. Commanders balance inspiring soldiers through leading by example with the need to maintain C2 continuity.<sup>11</sup>

This definition provides an implied task of extending required communications to the location of the commander and not solely to the command post or operations center. With the commander on the move, high capacity C4ISR solely to the command post does not serve his needs. As he moves, so does command. The personal involvement of the commander and his capability to maintain C2 continuity are not mutually exclusive with modern information technology. Modern information systems allow C4ISR services to follow the commander at all times at all locations. Commanders should not have to decide between information and mobility, but should expect to conduct battlefield circulation while possessing complete command and control of his forces enabled by robust C4ISR.

Commanders influence the battle in several ways. The commander's intent is critical to successful operations. A subordinate commander, armed with a full understanding of his higher commander's intent, can execute independent operations without further communications and guidance.<sup>12</sup> This doctrinal philosophy is critical during the rare instances when technology and communications fail severing the direct link among commanders. "Even when equipped with advanced C2 systems, commanders carefully consider their personal location and its impact on

their ability to recognize opportunities.”<sup>13</sup> Personal command presence is critical for a commander to understand fully the context in which his forces are engaged. Information systems and commander’s intent allow him to sustain command of all forces spread across the unit’s area of operation.

Communications support to commanders must be continuously revised to meet the ever-increasing information requirements. The explosion of information technology across the globe has significantly enhanced the command and control capabilities of the nation’s greatest adversaries to include the identified targets in Iraq and Afghanistan. The accepted doctrinal processes (OODA, F2T2EA, F3EA) are characterizations of decision making cycles that exist regardless of ideologically persuasion of the leader.<sup>14</sup> The successful commander continuously reduces the time sequence of the cycle in order to place the enemy off balance and eventually defeat them. Mobility communications enhance this ability to make informed decisions faster and represent a significant advantage for the commander over his adversary.

Just as the doctrinal labeling of the intelligence-operations cycle is required to understand how to teach and inculcate the fusion of previously separate and sequential activities, doctrine must be redefined in means of employing combat forces in the varied environments of Iraq and Afghanistan. Similarly, organized units must adapt to the urban operations of Baghdad or Mosul as easily as the western desert of Al Anbar Province in Iraq or the mountains of Nuristan and the countryside surrounding Jalalabad, Afghanistan. Each environment includes unique challenges for maneuver as well as communications. The rugged terrain of Afghanistan channelizes maneuver forces while the terrain isolates them from the tactical, line-of-sight communications readily available to a combat element in the open desert of western Iraq. Baghdad identifies the uncertainty of urban warfare with the saturated frequency spectrum of a major metropolitan area

flush with taxi radios, television broadcasts, and radio stations reciprocally interfering with the signals. Today, combat forces are employed and responsible for operations in areas much larger than the doctrinal norm. Additionally, the counterinsurgent fight requires quick reaction to emerging enemy actions. With sufficient C4ISR, the commander proactively brings the fight to the enemy and addresses the underlying sources of the insurgency. Commanders of combat forces must remain mobile and untethered to static operations centers in order to assess the varied situations involving their forces. FM 3-0 presents this necessity for a mobile commander:

On any given day, a conventional BCT commander might be simultaneously focused on targeting a cell leader in an IED network, providing security for a very important person convoy, monitoring a potentially violent demonstration, or responding to troops in contact—to name only a few potential operations...This successful intelligence operation is directly attributed to the enhanced agility possessed by commanders at the lowest level, enabled with corps assets, to orchestrate FMV [Full Motion Video] assets based on rapid feedback from intelligence analysts supporting the commander.<sup>15</sup>

Traditionally, commanders receive the best communications support from a fixed location supported by heavy tactical, government-owned or commercial communications systems, "...the command post is normally the focus of information flow and planning. There, information systems, the staff, and the COP [Common Operating Picture] enhance commanders' ability to visualize possibilities and recognize opportunities."<sup>16</sup> The heavy, commercially designed communications systems installed at a command post or operations center allow the full fusion of information via resident tactical, operational, and strategic communications systems. These information systems allow the commander to remain engaged with all elements of his organization. Typically supported by a variety of means, a modern command post provides the commander with a reasonably comparable level of service to that of a garrison or more permanent location. This level of communications support is the standard to which all systems and locations should be measured. The standard does not decrease upon departure from

the command post and the requirement remains the same as the commander circulates the battlefield. Information technology exists to meet this requirement. Likewise as an integral element of combat, mobility platforms must support this requirement.

Today, leaders command from forward locations as frequently as they command from their unit's command post. Mobility is necessary to achieve the critical level of operational awareness or infusion of leadership. Traditionally, a command and control communications blackout occurred as soon as the commander exited the tent flap to move to a forward combat location to assess the operations from the ground. The objective for future communications support must be to eliminate the communications blackout period and assure continuous communications to the commander that includes all available services found at the fixed operations center.

A commander should not endure degraded communications capability with a change of location. FM 3-0 identifies the benefits of communications systems in maintaining command of dislocated forces. Although the excerpt implies the command post as the focus of information, the commanders place themselves at decisive points of the battle while retaining full C4ISR capabilities:

Information technology helps commanders lead by allowing them more freedom to move around the battlefield while remaining connected electronically to the command post. This capability allows commanders to add their personal observations and feel for the ongoing operation to the synthesized information in the COP. Commanders can increase face-to-face contact with subordinates at decisive points without losing sight of the overall situation.<sup>17</sup>

Commanders will circulate the battlefield while maintaining command. Mobility platforms must be capable of providing full communications support at all times. The universal solution requires leadership and direction from the Air Force.

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<sup>10</sup> Field Manual 3-0. *Operations*, June 2001, 5-1.

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<sup>11</sup> Ibid, 6-18

<sup>12</sup> Ibid, 6-2

<sup>13</sup> Ibid, 6-18

<sup>14</sup> Observe, Orient, Decide, Act (OODA), Find, Fix, Track, Target, Engage, Assess (F2T2EA), Find, Fix, Finish, Exploit, Analyze (F3EA)

<sup>15</sup> Raymond T. Odierno, Nichoel E Brooks, and Francesco P. Mastracchio, "ISR Evolution in the Iraqi Theater," Joint Force Quarterly, Issue 50, (3<sup>rd</sup> Quarter 2008): 55.

<sup>16</sup> Field Manual 3-0. *Operations*, June 2001, 6-18

<sup>17</sup> Field Manual 3-0. *Operations*, June 2001, 11-24.



## Current Air Force Support

The US Air Force identified the need for increased communications connectivity to passengers traveling in the cargo compartment of widebody aircraft in the 1990s.<sup>18</sup> The requirement originated from the Air Force's mission to support executive travel aboard aircraft and the need to support the President of the United States aboard Air Force One.<sup>19</sup> The Air Force Communications Agency foresaw the need to improve communications capabilities to the leaders aboard its transportation assets in order to maintain the individual's situational awareness while en route. Today, commanders' airborne informational requirements are consistent with the stated requirements aboard Air Mobility Command (AMC) aircraft identified by the Air Force more than a decade ago. Success on the modern battlefield requires that the identified C4ISR requirements become materially realized aboard all transport aircraft.

As stated, rapid mobility is the key to success in not only the counterinsurgency environment, but also at the operational and strategic levels of military maneuver. In justifying the need for a modernized fleet of mobility aircraft with compatibility, the Air Force stated, "Strategic mobility lies at the heart of a credible deterrence posture."<sup>20</sup> For the deterrence policy to be effective, the nation must be capable of moving its forces wherever possible in order to counter enemy aggression. In order for ground forces to be effective upon delivery, the forces must have access to information systems en route to conduct planning and preparation for ground combat. In a strategic response scenario, this level of C4ISR support is critical for the mission success and force protection. Since the fall of the Soviet Union, the number of conflicts has increased. The increased demand for tactical and operational mobility to support the near continuous operational tempo, identifies a corresponding need for C4ISR support while airborne. Information superiority over the increasing diversity of enemies is not possible without en route

communications capability aboard mobility aircraft. Communications systems to support a commander and his staff provide the capability to react within the enemy's decision cycle. In the Concept for Airborne C4I Capability written in 1995, the Air Force identified this requirement and implied its immediate availability through Commercial-off-the-Shelf (COTS) solutions. "When implemented, the Airborne C4I Architecture will extend to airborne platforms the same information technologies now commonly found in ground-based C4I systems. The resultant merger of ground and airborne systems into a seamless, interoperable architecture will bring airborne platforms into the..."<sup>21</sup> Global Information Grid (GIG). Inclusion in the GIG extends all required communications systems to an airborne platform thus enabling commanders to effectively command and control forces continuously.

Similar to the standard GIG, architectures such as Tactical Digital Information Link (TADIL) are in place to facilitate the rapid distribution of data among airborne and ground systems. The Services can leverage this architecture to extend the information directly to the commander in the cargo compartment of any airframe. As an extension of the GIG, the standardization in accessing information through systems such as TADIL facilitate the implementation and support to a global network and supports the expeditionary nature of the Armed Forces.

Rapid mobility across the battlespace and the globe is a key to credible employment of the military instrument of power.<sup>22</sup> In order to realize its full capability, mobility aircraft must be augmented with the C4ISR capability and information systems. Effective global power requires ground combat units to arrive fundamentally prepared for combat operations. This preparation includes the latest elements of friendly information, the enemy situation, and other extenuating diplomatic, economic, and cultural concerns. If the ground combat force is capable of landing

and immediately engaging decisive combat operations, US engagements will become more consistent with the short duration, limited casualty operations deemed acceptable to the nation's leaders. Once on the ground, the situation changes rapidly. The commander moves about the battlespace to command his forces from the location most effective for a particular situation. The movement of the commander and his forces takes precious time. The value of that time increases the longer the commander and his staff is not able to access standard information systems. To mitigate the impact on his information requirements, the commander requires a similar level of C4ISR support while mobile as provided him to him in the unit operations center. The only means to accomplish this task is to modify aircraft to receive a full complement of C4ISR capabilities.

The new standard for communications support must apply to all mobility platforms from rotary wing aircraft to intra-theater airlift. Intra-theater airlift is intrinsically longer in duration; therefore, the Services must place priority and emphasis on those systems, as it will provide the largest payoff to commanders and their staff by eliminating the lack of communications support for the long duration of the flight. The considerably longer duration of AMC airlift missions versus flights on rotary or smaller fixed wing airframes, presents a more significant and cost effective solution on board AMC strategic lift platforms. In order to remain effective for the full extent of a flight and available for any expeditionary force, the communications support package designed for installation aboard aircraft must be considered as a critical component of the whole airborne combat system along with the airframe and crew.

The Air Force identifies the need to consider passenger communications requirements when planning airlift missions.<sup>23</sup> Although in recent years, the Air Force has designed communications systems to support passenger communications, the impetus for coordination,

installation, and operation sits squarely on the passenger force today. The AMC and the crew focus on transporting personnel and equipment from the departure airfield to destination and not on passenger communications requirements. Consequently, they provide limited assistance in planning and implementation of communications systems aboard those aircraft where recent modification provides a rudimentary capability. The passengers install and operate the communications systems in the cargo area with no assistance from the aircraft crew. As a result, varieties of C4ISR systems solutions to meet specific needs are employed on mobility aircraft.

The onboard communications systems must be standard and compatible with ground information systems in order to be effective.<sup>24</sup> Standardization provides the Services a basis for training while institutionalizing the required parts list to sustain equipment. The expansion of the Global Information Grid in the past decade provided high capacity connectivity for US forces around the globe in fixed locations. Airborne platforms must be integrated in the GIG through planning and procurement of aircraft incorporating required C4ISR support to the cargo compartment. The extension of the GIG to airborne platforms requires little procurement expenditures in order to implement a robust solution. The communications entry points where airborne systems can enter the global architecture already exist at numerous locations around the world to support other tactical and mobile users. All required command and control communications networks reside at these entry points. The addition of a modern communications suite aboard aircraft would provide immediate access to the data, voice, and video services resident in existing operational, intelligence, and logistics networks already available to fixed ground operations centers.

The rapid movement of the modern battlefield requires the maximum amount of information to commanders at all levels. Commanders have the expectation to see every video,

enter every conference call, and receive every intelligence summary. This expectation requires the extension of all services to all available platforms, particularly aircraft, across the battlefield. Much like the Link system extends situational awareness and battlefield information to pilots and seamen, a robust, integrated system must cover the battlespace to extend all data, voice, and video services to all commanders in order to constrict the find, fix, and finish cycle through rapid evaluation and analysis. The Link architecture provides a basic architecture design that may be leveraged to provide commanders with an increased capability to effect operations through increased C4ISR.

For decades, Special Operations Forces (SOF) understood the need to retain C4ISR connectivity at all points of an operation and have leveraged existing commercial and military architectures to meet minimal communications requirements in support of limited mission sets. SOF commanders no longer suffer the blackout in communications en route once the ramp of the cargo area closes. Other forces will benefit from SOF has learned over several decades of trial and error.

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<sup>18</sup> Air Force Command, Control, Communications and Computer Agency. *White Paper*. 31 December 1995

<sup>19</sup> USAF Statement of Need #7-82, Subject: Modification of Long Range Presidential and Distinguished Visitor Support and Airlift Capabilities

<sup>20</sup> Airlift and the US National Security: The Case for the C-17. 1991

<sup>21</sup> Headquarters, United States Air Force. *Concept for Airborne C4I Architecture*, 31 July 1995

<sup>22</sup> Joint Publication 3-17, *Joint Doctrine and Joint Tactics, Techniques, and Procedures for Air Mobility Operations*, (14 August 2002): vii

<sup>23</sup> Ibid, VII-4

<sup>24</sup> Systems Specifications (FOUO), Subject: AF-1 Replacement Program Model 747, Revision A, 15 SEP 1987.

## Special Operations Forces Requirements

US forces in Iraq and Afghanistan continue to perfect the find, fix, finish, exploit, and analyze (F3EA) cycle to track, target, and eliminate terrorists from the battlefield with ever-increasing effectiveness and efficiency. Due to advancements in technology, this cycle has expanded operations beyond the hours of darkness, typically the period of greatest advantage for US forces, to a 24 hour, nearly continuous presence of highly skilled forces placing pressure on the enemy. The advent, and subsequent increasing use, of airborne ISR systems has enabled the saturation of suspected areas. This, combined with human intelligence and other technical means, refines suspected enemy areas of interest until the target is fixed. The spotlight of all available intelligence assets focuses on the exact location so that the target may be finished kinetically or via ground assault. Regardless of the finish technique, exploitation elements accompany assault elements and descend on the target site to wrest control of available information ranging from computer hard drives to pocket litter. The rapid exploitation of the site leads to immediate analysis and the onset of the F3EA cycle all over again. The cycle repeats itself through multiple iterations in a single period of darkness, thus not allowing the enemy to rest, recuperate, or relocate. SOF doctrine concerning the use of the F3EA cycle has migrated to conventional forces as a “best practices” solution to the resolution of counterinsurgency operations combined with new technologies.<sup>25</sup>

Other SOF practices concerning communications and aircraft could prove to be an adopted standard for general purpose forces (GPF). SOF employs several communications systems adapted for easy installation and operation aboard various Air Force Special Operations Command (AFSOC) and AMC aircraft in order to provide senior leaders the necessary connectivity in order to retain a standard battle rhythm while in transit. These “plug-n-play”

systems are state of the art communications equipment combined with aircraft modifications to provide a complete system that provides rudimentary command and control communications while airborne. The system provides a reduced capability of all available resources resident at a ground command post enabling limited command and control of combat forces while aboard the aircraft. A modernized, state-of-the-art communications solution could provide a command and control experience more consistent with a ground operations center than the SOF developed solution.

The holistic SOF approach to extending communications requires the airframe and communications system be viewed as a single system. The communications systems onboard the aircraft is of no value to the commander without a functioning antenna system externally affixed to the airframe providing access to the GIG. Subsequently, the mobility aircraft combat systems consist of the onboard communications systems and the radiating antennas on the modified airframe. SOF elements have taken available equipment to meet an urgent requirement. C-17 aircraft have been specifically modified to support SOF's Special Operations Low Level mission set. These aircraft include antenna systems to extend C4ISR from the GIG via commercial satellite systems. This ad hoc system comprised of available equipment and systems provides performance for critical C4ISR systems comparative to a typically slow home internet dial up speed. As a result, intelligence and operations products are reduced and tailored to the limitations of the communications systems instead of the commander's information requirements. Systems installed on business jets and commercial airliners today are more capable and appropriate for support of commanders. These commercial systems are the best of breed, far superior to the current SOF solution, and should be adopted as the doctrinal requirement for widebody AMC aircraft.

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<sup>25</sup> Michael T. Flynn, Rich Juergens, and Thomas L. Cantrell, “Employing ISR: SOF Best Practices,” Joint Force Quarterly, Issue 50, (3<sup>rd</sup> Quarter 2008): 57.



## The Cost

The ISR systems and enhanced SOF tactics, techniques, and procedures (TTP) in use in Iraq and Afghanistan today assume the communications systems will be on-hand to support the explosion of the information available to the commanders across the battlefield. The cost of providing this capability to commanders in order to facilitate their effectiveness will be high. Is the increased command effectiveness worth the cost? The cost of including passenger communications for all cargo aircraft is significant, but the improved effectiveness may be immeasurable. Particularly in long duration flights, commanders and staff have traditionally been absent from decision cycles due to the lack of available or sufficient communications aboard mobility aircraft. The addition of communications equipment and external antennae on the aircraft fuselage will reduce the duration of the blackout periods in the decision-making process.

Obviously, the addition of communications to mobility airframes comes with a cost. To meet the command and control communications expectations of leaders, the Services will have to establish multiple programs. The existing airframes must be modified while a stated requirement must be levied on manufacturers to incorporate requirements into new aircraft. Additionally, the GIG program must account for the extension of services to airborne platforms requiring a modification to deployed communications support. With the communications systems added as an organic element of the aircraft, the Air Force becomes a communications service provider to elements of all Services aboard their airframes. The new capability on an aircraft requires added training and possibly additional persons onboard the aircraft to provide assured communications to the passengers.

As stated previously, several Department of Defense organizations have identified requirements for airborne command and control or for en route communications over the recent past. Specifically, United States Special Operations Command (USSOCOM) has levied requirements on the Air Force to provide this capability in support of commanders and staff and mitigate the C4ISR blackout that occurs during contingency operations. SOF commanders possess the capability to command and control from airborne platforms. This capability originated from the need for tactical communications within line-of-sight of the objective. However, the evolution of over-the-horizon communications has relegated these dangerous tactical missions obsolete. The requirement has progressed into sustaining connectivity while transiting to and from an operational area. USSOCOM has the resources to construct or adapt an airframe for this specific mission, but the condition now exists for the conventional forces to have the same capability. The requirement to provide in transit communications architecture has become increasingly clear. Specialized airframes, specific to SOF or other subset of the Services, would be inefficient and costly and not meet the GPF's needs.

User provided solutions, similar to the SOF systems in place now, provide a specific reachback capability to SOF specific resources. SOF instituted this system in the absence of a suitable Service solution using funding lines specific to the unique requirements of SOF. The SOF systems extend services from fixed SOF locations such as MacDill Air Force Base, Florida or Fort Bragg, North Carolina where GPF information systems may not be resident. Recent counterinsurgency operations and the Air Force's support to executive travel have proven these requirements are not unique to SOF, but would benefit GPF as well. As a result, the solution cannot be unique to SOF or other subset of the Services. All forces must have access; therefore, a generalized solution that supports any element is necessary. Undoubtedly, a user-developed

solution would vary in equipment composition and architecture to access required information. A global solution installed, operated, and maintained by the aircrew is more efficient and less costly. The program solution should incorporate airframe modifications to support external antennas, internal communications suites, and a global architecture supporting access to C4ISR systems from anywhere in the world.

Without dedicated strategic airframes within SOCOM, or the justification to build a SOF unique aircraft to provide commanders with the C4ISR requirements while airborne, USSOCOM modifies airframes to provide enhanced communications capabilities in support of the SOLL mission. The identification of a SOLL requirement by USSOCOM to the Air Force requires a significant reaction on behalf of the Air Mobility Command and Boeing who still possesses configuration management for the C-17 aircraft.<sup>26</sup> Previously, the Air Mobility Command identified specific airframes to receive special modifications in order to support the SOLL mission. The modifications included external antennae to support communications via the International Maritime Satellite (INMARSAT) network. This connectivity was an enhancement over single channel, tactical satellite by enabling the extension of INTERNET protocol networks. Commanders now possessed the capability to move with a semblance, although significantly reduced from garrison networks, of command and control communications system.

The SOCOM project provides an external antenna attached to the maintenance-ditch hatch of the C-17 Globemaster III. This modification meets a stated requirement to extend higher bandwidth communications systems for en route planning. The Hatch Mounted Satellite Antenna – INMARSAT (HMSA-I) project provides special operations forces a slide in capability to enhance communications connectivity onto any existing C-17 airframe. The plug and play intent includes a “no scar” design that allows the capability to be applied to any airframe.<sup>27</sup> The

INMARSAT connectivity provides multiples of the bandwidth of a standard dial-in internet phone service at a cost of several dollars per line per minute. The cost compared to the technologically obsolete service provided by the modification identifies this as an interim solution to a significant requirement. The relatively small bandwidth, space-based systems process information with significant latency when accessing ground based networks. The delay in retrieving or pushing information could be catastrophic to commanders and his forces involved in ongoing operations. The INMARSAT constellation covers a large majority of the globe with denser coverage of probable strategic mobility deployment routes. Higher bandwidth capabilities provided by global satellite constellations are required to meet current requirements. Eventually, the C-17 airframe will require additional modifications to meet the current communications needs.

The cost of the USSOCOM C-17 INMARSAT modification was approximately \$10.7 million in 2006 and included a subset of the entire Air Mobility Command fleet of C-17 aircraft.<sup>28</sup> The cost and the capability are insignificant when viewed against the larger scale of SOCOM, USAF, or Department of Defense budget. As with most contracts, the cost of the USSOCOM application decreases significantly, as more packages are ordered.<sup>29</sup> The logical assumption may be made that the overall cost would be significantly less expensive when and if included in the original design of an aircraft instead of preplanned, or unplanned, improvement. All widebody USAF aircraft may provide transportation to commanders and should possess the capability to extend command and control communications as identified in the AFC4A (Air Force Command, Computer, Control, Communications Agency) white paper.<sup>30</sup> The SOCOM solution is unique to the C-17 airframe and should be applied across the AMC and Army fleet of mobility aircraft to include C-27J Spartan, C-130 Hercules, and all tanker variants. Additionally,

the system must be flexible to provide rapid modification as technology advances to meet the ever-increasing information requirements.

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<sup>26</sup> Boeing Airborne Integrated Project Team. “C-17 Hatch Mounted Satellite Antenna – INMARSAT (HMSA-I) Feasibility Study.” 18 May 2006

<sup>27</sup> Boeing Airborne Integrated Project Team. “C-17 Hatch Mounted Satellite Antenna – INMARSAT (HMSA-I) Feasibility Study.” 18 May 2006

<sup>28</sup> Boeing Airborne Integrated Project Team. “C-17 Hatch Mounted Satellite Antenna – INMARSAT (HMSA-I) Feasibility Study.” 18 May 2006

<sup>29</sup> Boeing Airborne Integrated Project Team. “C-17 Hatch Mounted Satellite Antenna – INMARSAT (HMSA-I) Feasibility Study.” 18 May 2006

<sup>30</sup> Air Force Command, Control, Communications and Computer Agency. *White Paper*. 31 December 1995

## Future Solutions

The combat system – aircraft, aircrew, communications system, etc. – designed to deliver expeditionary forces to the battlefield must include the required information technology to provide C4ISR to the transiting force. The Air Force identified the Air Operations Center as a weapons system known as the AN/USQ-163 Falconer in order to train and equip disparate specialties to function effectively with a single purpose in combat. Similarly, the addition of communications to the mission set of the aircrew appears to add an unrelated skill to the aircrew. Aircrew and the deploying force must work together to meet the singular purpose of placing combat power in a location prepared to fight. The deploying force requires the support of the aircraft combat system to deploy, fight, and win. This approach is required for the C4ISR systems aboard mobility aircraft in order to provide a trained and resourced pool of airmen and airframes to meet combat requirements. The weapons systems designation will ensure standardization of the command and control communications similar to other aspects of a program. Once considered an organic capability of an existing weapons system, the Department of Defense will apply the associated level of training and funding through the appropriate Service. All Services require the capability and will benefit from it once installed. Therefore, the requirement must be considered Joint. In order to ensure success, the Department of Defense should identify a single Service for development and implementation of a complete system to support passengers. The logical Service to implement and operate this capability is the USAF, but the USAF alone should not bear the burden for funding a capability that will be of equal benefit to all Services and USSOCOM.

The greatest advantage to the USAF of applying a universal solution to all airlift platforms is the elimination of the requirement to manage limited capabilities aboard specific tail

numbers. Once all airframes possess similar capability, then critical airlift platforms will not be held in reserve to support possible missions. AMC may select and divert any aircraft in system to meet priority missions. A fleet of airframes with identical capabilities increases flexibility while reducing response time.

The primary deficiency in enhancing the communications connectivity of existing airframes in the military inventory is that they are in fact already in service. The modification of airframes to add external communications capability is costly and time consuming particularly for airframes such as the C-17 whose design control is still under Boeing.<sup>31</sup> Similarly, communications design requirements for new systems such as the Joint Cargo Aircraft, C-27J Spartan, are too far down the acquisition path to effect requirements. The users of the cargo compartment of these systems must demand communications capabilities that provide services on par with ground Tactical Operations Centers or garrison offices. This capability will allow commanders at all levels to remain engaged during the full cycle of combat operations.

Organizations have developed expedient means to ensure connectivity like the replacement of escape hatches with hatches modified by airworthy antennas. This technique provides the cargo compartment with a limited means of reaching their subordinate organizations and remaining in contact. This capability is unique to those elements with the financial means to develop and implement a solution for a specific purpose. The typical conventional unit does not possess the resources to provide what has become a general-purpose requirement. Additionally, the solutions are unique to the ground organizations and are not organic to the crew. As a result, the planning and sustainment of this currently peripheral task is of limited concern to the Air Force crew. Planning for employment of current systems and equipment modernization falls to

the ground force desiring the communications service. As a result, expensive, unique solutions have been developed at the expense of an overall inclusive architecture.

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<sup>31</sup> Boeing Airborne Integrated Project Team. “C-17 Hatch Mounted Satellite Antenna – INMARSAT (HMSA-I) Feasibility Study.” 18 May 2006



## Recommendations and Conclusion

The need for commanders, leaders, and staff to retain – at a minimum – situational awareness, but preferably full command and control faculties, while airborne is achievable and an identified requirement during OIF and OEF.<sup>32</sup> The expanse of information available to commanders and the speed of operations dictate the need for continuous contact with all available maneuver forces.

The technological advancements require mature, well-informed senior commanders to discern the important intelligence and operational situational awareness from the increased flow of information available to him. The large amounts of information available to commanders must be viewed solely as a positive from those Services and agencies that provide the capability. The commanders have the responsibility to train staff and subordinate units to tailor information to his needs to support the rapid operations across the battlespace. The specific manhunting mission requires patience and dedication both in personnel and equipment.<sup>33</sup> The success of manhunting missions has validated and obviated the need for the employment of multiple orbits of ISR systems.<sup>34</sup> The immense amount of information emanating from these platforms stresses communications networks as well as staffs and commanders. The fixed operations centers established throughout Iraq and Afghanistan receive communications support from state of the art, commercial systems capable of high capacity bandwidth. Yet, these communications systems have difficulty transmitting full quality video information to the operations centers. The true dilemma registers when the commander is not present at the operations center, but requires the same level of communications support while en route to or circulating the battlefield. Commanders demand this level of service and the acquisition and communications agencies of the various Services must devise means in which to provide unfettered command information

regardless of the location of the commander. Data links such as Tactical Digital Information Links (TADIL) represent an architecture that supports the movement of information with rapid assuredness across the battlefield.<sup>35</sup> This architecture design identifies a parallel system developed to increase the command information available to leaders in mobility platforms of all sizes and flight duration.

A similar, but enhanced, capability present in each mobility aircraft for use of commanders in the cargo compartment will increase the effectiveness of Joint combat forces. The development of a capability in a few or select numbers of Air Force and Army cargo aircraft versus fleet wide is ineffective and complicates the employment of mobility aircraft by dedicating specific tail numbers to specific missions. The commanders of all Services require movement from one location to another while maintaining continuous communications with their staff and subordinate units. The adaptation of the complete inventory of aircraft and the inclusion in the design specifications of future aircraft will add cost to expensive programs, but greatly increase the effectiveness of US military forces in a dynamic and emerging battlespace. The inclusion of “plug and play” communications systems or easily modifiable external antenna systems at the onset of a program is more effective and less expensive than the post-production modification of an existing fleet. All Services must recognize the need and include the requirement in initial production in order to reduce cost while increasing effectiveness and capability.

At the Joint level, direct the modification of publications to direct the need. For instance, Joint Publication 3-17, Joint Doctrine and Joint Tactics, Techniques, and Procedures for Air Mobility Operations, should redefine airlift to add the requirement to provide communications support to the cargo compartment of all systems. The document should be modified to read,

“Airlift forces conduct operations through the air to transport personnel and materiel in support of strategic, operational, and tactical objectives and to deliver these personnel and materiel via airland or airdrop methods...” **while sustaining C4I connectivity for passengers.**

The same Joint publication already identifies the need for consideration of communications requirements for the deploying ground force. The publication does not identify the resources to accomplish this mission or determine where the mission begins and ends.

#### CONSIDERATIONS FOR AIRLIFT PLANNING

- ✓ Airlift Facilities
- ✓ Facility Support Forces
- ✓ Operation of Aerial Ports
- ✓ Intermediate Staging Base
- ✓ In-transit Visibility
- ✓ Air Base Defense
- ✓ Joint Airspace Control
- ✓ Air Corridors or Operating Areas
- ✓ Weather
- ✓ Threats
- ✓ Threat Countermeasures
- ✓ Air Refueling
- ✓ **Communications for Deploying Ground Forces**

Recognition of the requirement is always the first step towards a solution. The publication provides some direction on the automated information support to the air mobility element in order to maintain in-transit visibility. The plethora of communications systems to ensure situational awareness among all elements in theater should be enlarged to provide the needed communications support to commanders in transit. In the draft field manual for Network Operations, FM 6-02-71, the Army has identified the need for continuous connectivity and designated the Division G6 staff element the responsible element.

Maintains network connectivity across the division, to include units deployed to the AOR, units en route to the AOR, and units at home station.

Unfortunately, the Division G6 is unable to complete this mission without proper equipment and support from the USAF's Air Mobility Command and adequately outfitted aircraft to maintain connectivity to, "...units en route to the AOR."<sup>36</sup> Communications systems are available, but in order to be effective, the en route mission must take the standard Air Force approach and designate the supporting communications equipment and the aircraft together as a combat system. Without appropriate antenna systems on the external surface of the aircraft, state-of-the-art communications systems in the cargo compartment of any aircraft are of no value to the commanders. Antenna emplacement systems should be engineered in such a manner as to easily and affordably upgrade the hardware without

1. Endangering the aircraft
2. Requiring a lengthy reengineering of the airframe
3. Slowing the need upgrade to the cargo compartment

USSOCOM has developed upgrades to the C-17 aircraft to increase the capacity of communications to the backend of the aircraft with existing technologies. Previous modifications to specific C-17 airframes have hindered the ability to add the needed capability. The shortsighted view of immediate improvement versus meeting the true objective has to be weighed when determining a material solution.

The cost of modifying existing aircraft or including enhanced cargo compartment communications systems in future aircraft is significant. The demand for such aircraft will continue to increase and modifications will develop to meet requirements. The successful implementation of aircraft modifications will prove sufficient for a specific purpose by a specific organization. The difficulty arises as separate organizations develop unique or varying solutions for their particular mission sets when a general, centrally managed solution will prove more efficient and, more importantly, more effective. The long-term cost of training and maintenance

of a number of mission unique systems may prove to be more expensive than the initial investment to standardize the requirement.

The information age has had a dramatic impact on the conduct of leadership in the modern military. The military appears as a representation of the society it defends. Information technology is a critical component to the decision making of leaders in all professions. Similar to general society, in the military, the application of information technology determines the survival of forces through the commander's capability to act in an informed way. Conversely, the forces cannot afford for commanders to be out of contact with them during movement around the battlefield. For this reason, the Services should make every attempt to assure connectivity in airborne platforms as quickly as possible.

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<sup>32</sup> Michael T. Flynn, Rich Juergens, and Thomas L. Cantrell, "Employing ISR: SOF Best Practices," *Joint Force Quarterly*, Issue 50, (3<sup>rd</sup> Quarter 2008): 59.

<sup>33</sup> *Ibid*, 59

<sup>34</sup> *Ibid*, 61

<sup>35</sup> Field Manual 6-24.8 / AFTTP(I) 3-2.27. *Introduction to Tactical Digital Information Link J and Quick Reference Guide*. (June 2000): II-1

<sup>36</sup> Field Manual 6-02.71, *Network Operations*, 31 July 2007, D-2

## Bibliography

- Air Force Command, Control, Communications and Computer Agency. *White Paper*. 31 December 1995
- Air Force Doctrine Document 2-7. *Special Operations*, July 1999.
- Asymmetric Warfare Group, F3EAD Personality Targeting: Commander's Handbook/Pocket Guide, 1 August 2007.
- Boeing Airborne Integrated Project Team. "C-17 Hatch Mounted Satellite Antenna – INMARSAT (HMSA-I) Feasibility Study." 18 May 2006
- Clausewitz, Carl von. *On War*. Edited and translated by Michael Howard and Peter Paret. Princeton, NJ: Princeton University Press, 1976.
- Dodson, John R. "Man-hunting, Nexus Topography, Dark Networks and Small Worlds," Joint Information Operations Center, Winter 2006.
- Field Manual 3-0. *Operations*, June 2001.
- Field Manual 6-02. *Signal Support to Army Operations*. June 2001.
- Field Manual 6-02.71, *Network Operations*, 31 July 2007.
- Field Manual 6-24.8 / AFTTP(I) 3-2.27. *Introduction to Tactical Digital Information Link J and Quick Reference Guide*. June 2000.
- Flynn, Michael T., Juergens, Rich and Cantrell, Thomas L., "Employing ISR: SOF Best Practices," Joint Force Quarterly, Issue 50, (3<sup>rd</sup> Quarter 2008): 57-61.
- Garreau, Joel. *Radical Evolution*. New York, NY: Doubleday, 2005.
- Globalsecurity.org. "Joint Cargo Aircraft (JCA)," <http://www.globalsecurity.org/military/systems/aircraft/jca.htm>
- Globalsecurity.org. "C-27J Spartan." <http://www.globalsecurity.org/military/systems/aircraft/c-27j.htm>
- Headquarters, United States Air Force. *Concept for Airborne C4I Architecture*, 31 July 1995
- Hughes, Alexander Thomas. *Overlord: General Pete Quesada and the Triumph of Tactical Air Power in World War II*. New York, NY: The Free Press, 1995.
- Odierno, Raymond T., Brooks, Nichoel E., and Mastracchio, Francesco P. "ISR Evolution in the Iraqi Theater," Joint Force Quarterly, Issue 50, (3<sup>rd</sup> Quarter 2008): 51-55.

Joint Forces Command, Commander's Handbook: Find, Fix, Exploit, Analyze, and Disseminate (F3EAD) High Value Individual (HVI) Targeting (DRAFT).

Joint Publication 3-0, *Joint Operations*, 13 February 2008.

Joint Publication 3-17, *Joint Doctrine and Joint Tactics, Techniques, and Procedures for Air Mobility Operations*, 14 August 2002

Joint Publication 3-52, *Joint Doctrine for Airspace Control in the Combat Zone*, 30 August 2004.

Joint Publication 3-60, *Targeting*, 13 April 2007.

Kissinger, Henry. *Diplomacy*. New York, NY: Simon and Schuster, 1994.

Lonsdale, David J. *The Nature of War in the Information Age*. New York, NY: Frank Cass, 2004

Performance Work Statement for the Future Cargo Aircraft. Future Cargo Aircraft Product Directorate.

[http://74.125.45.104/search?q=cache:ri89GcsSrT0J:https://wwwproc.redstone.army.mil/acquisition/padds/web/W58RGZ06R0213/attach\\_exhib/PWS0012.DOC+%22joint+cargo+aircraft%22+%22statement+of+work%22&hl=en&ct=clnk&cd=1&gl=us](http://74.125.45.104/search?q=cache:ri89GcsSrT0J:https://wwwproc.redstone.army.mil/acquisition/padds/web/W58RGZ06R0213/attach_exhib/PWS0012.DOC+%22joint+cargo+aircraft%22+%22statement+of+work%22&hl=en&ct=clnk&cd=1&gl=us)

Quadrennial Defense Review Report. 6 February 2006

Sun Tzu. *Art of War*. Edited and translated by Ralph D. Sawyer. Boulder, CO: Westview Press, 1994

The National Military Strategy of the United States of America."A Strategy for Today, A Vision for Tomorrow." 2004

The United States Army. "2004 Posture Statement." <http://www.army.mil/aps/04/index.html>.

The United States Army. "2006 Army Modernization Plan."  
<http://www.army.mil/features/MODPlan/2006/>.

The United States Air Force. "2007 U.S. Air Force Posture Statement."  
<http://www.posturestatement.hq.af.mil/>.

United States Special Operations Command. "Posture Statement 2006."